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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/530,319	11/05/2005	Guenter Hoenig	10191/3753	3633

26646 7590 06/22/2010

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EXAMINER	
PRICE, CARL D	
ART UNIT	PAPER NUMBER
3749	

MAIL DATE	DELIVERY MODE
06/22/2010	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/530,319	HOENIG ET AL.	
	Examiner	Art Unit	
	Carl D. Price	3749	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *29 March 2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *11,-18,20 and 22-24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *11,12,14-18,20 and 22-24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims **11, 12, 14-18** and 20-**24** have been considered but are moot in view of the new ground(s) of rejection.

Applicant has amended the claims to be of a scope not previously considered. Consistent with applicant's argument that the prior art relied on in the previous office action fail to show, disclose and/or teach certain aspects of applicant's invention now recited in the claims filed on **03/29/2010,** applicant has amended the claims to include at least the following:

11. (Currently Amended)

An afterburner for afterburning a residual gas from at least one of a reforming process and a fuel cell process, comprising:

at least one nozzle to meter fuel and the residual gas into a combustion chamber;
at least one device for providing an air supply;
a heat-resistant, open-pore ceramic foam for at least partially filling the combustion chamber; and
an ignition device arranged as being one of installed in and formed integrally with the ceramic foam,
wherein the ceramic foam includes silicon carbide,
wherein the ceramic foam is configured to conduct heat via **a wall** the combustion chamber to the at least one of the reforming process and the fuel cell process.

23. (New)

The afterburner as recited in Claim 11, further comprising:

a flame area which extends from the at least one nozzle to an outlet chamber.

24. (New)

The afterburner as recited in Claim 23, wherein:

the flame area extends in an oval shape through the ceramic foam.

With regard to the previous Objection to the Drawings, applicant argues the following:

> "… that "conventional features disclosed in the description and claims, where their detailed illustration is not essential for a proper understanding of the invention, should be" -- but are not required to be -- "illustrated in the drawing in the form of a graphical drawing symbol or a labeled representation." The features of "the at least one of the reforming process and the fuel cell process," a "glow plug," and "the at least one nozzle includes one of a swirl nozzle and a multi-orifice nozzle" need not be illustrated since a detailed illustration thereof is not essential for a proper understanding of the claimed subject matter."

The examiner concedes that features such as the "a glow plug" are indeed of a convention nature so as to not be required to be shown in the drawings. That is, since the drawings do show a wire filament type igniter heater which would in itself convey to the person having ordinary skill in the art the general understanding of the applicant's use of a resistive type igniter heater, such as for example, a "a glow plug". However, the examiner does not agree with applicant's contention that the features of "the at least one of the reforming process and the fuel cell process," and "the at least one nozzle includes one of a swirl nozzle and a multi-orifice nozzle". Indeed, it is inconsistent for applicant to suggest both that the limitation(s) of "the at least one of the reforming process and the fuel cell process" need not be shown in the drawing figure because it is not essential for a proper understanding of the invention while at the same time presenting arguments and supporting amendments to the claims intended to make the case that these same features (i.e. – "wherein the ceramic foam is configured to conduct heat via **a wall** of the combustion chamber to the at least one of the reforming process and the fuel cell process.) are necessary to the combination of claimed elements making up the invention. Furthermore, with regard to "the at least one nozzle includes one of a swirl nozzle and a multi-orifice nozzle" applicant's attention is directed to the following discussion presented in the application specification (pages 2 and 5):

"As an alternative to or in support of the use of high fuel pressure, solutions are known that use air to assist in the fine atomization of the fuel, the fuel or residual gas being swirled before combustion by air for a sufficiently long period. Here, the disadvantage is the relatively large amount of space required, the complex and unreliable regulation of the metering of the air, and the additional amount of power required."

"A further advantageous refinement results when the nozzle is designed as a swirl nozzle, making possible an even better fuel distribution."

From the forgoing, it can be seen that at least the use of "at least one nozzle includes one of a swirl nozzle" is indeed necessary and essential for a proper understanding of the invention, at least to make it possible an even better fuel distribution. However, absent the proper showing a swirl nozzle in the drawing figures a person having ordinary skill in the art would have no further understanding of the manner in which applicant might have intended to employ features such as a swirl nozzle and/or a multi-orifice nozzle along with those other feature which are illustrated to, for example, accomplish an even better fuel distribution.

The examiner is therefore not convinced that the features of a convention nature so as to not be required to be shown in the drawings and "the at least one nozzle includes one of a swirl nozzle and a multi-orifice nozzle". These elements and are therefore required to be shown in the drawings.

In response to the prior art of record cited in the previous examiner's action and in support of the scope of the invention now presented in the amended claims, applicant argues the following:

> "Claim 11 relates to an afterburner for afterburning a residual gas from at least one of a reforming process and a fuel cell process, including, inter alia, at least one nozzle, at least one device for providing an air supply, a heat-resistant, open-pore ceramic foam for at least partially filling the combustion chamber, and an ignition device arranged as being one of installed in and formed integrally with the ceramic foam, **in which the ceramic foam is configured to conduct heat via a wall of the combustion chamber to the at least one of the reforming process and the fuel cell process."** (Bolding and Highlighting added)

In response to applicant's argument(s) directed to the prior art previously relied on, and in response to the scope of the invention now set forth in the presently amended claims, the following examiner's action again relies on the prior art reference of **US 6190623**.

US 6190623 teaches that it is known to configured a porous combustion material (220, 225, 217, 227) to conduct heat via a wall (237) of the combustion chamber to the at least one of

the reforming process and the fuel cell process. And, wherein the fuel combusted in the porous member is anode waste gas from the fuel cell zone is essentially completely combusted.

Applicant is reminded applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.,* 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

Accordingly, while applicant's arguments have been carefully considered, applicant's claims do not patentably distinguish applicant's invention over the prior art of record.

See the examiner's action herein below.

Drawings

The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, wherein "the at least one of the reforming process and the fuel cell process (claim 11) and "the at least one nozzle includes one of a swirl nozzle and a multi-orifice nozzle" (claim 22) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 11, 12, 14-18 and **20-24** are rejected under 35 U.S.C. 103(a) as being unpatentable over **US 6003305 (Martin et al)** in view of **US 6077620 (Pettit), US 20010028867 (Shimoda et al)** and **US 6190623.**

US 6003305 (Martin et al) shows and discloses an exhaust gas afterburner including a ceramic foam matrix, an oxidizer inlet 17, a fuel stream 5 and wherein a catalytic section 31 includes a resistive heating element or " glow plug" (30) that protrudes into matrix 14a.

US 6003305 (Martin et al) discloses and shows:

(6) An e**ngine exhaust tube 43** for directing engine exhaust stream 3 is coupled to oxidizer inlet 17. Depending on the characteristics of engine exhaust stream 3, it may be advantageous to add an air stream 4 to supply additional reactant oxygen, as well as a supplemental f**uel stream 5 to supply reactant fuel.** In such circumstances, an air supply tube 44 and a supplemental fuel tube 45 may be coupled to inlet 17 or may be coupled to a port through matrix shell 22a so as to bypass a portion of matrix 14a. **Air stream 4** may be pre-heated by incorporating a heat exchanger (not shown) into **air supply tube 44**.

(8) **Matrix 14a** comprises a bed of solid, heat-resistant media through which process stream 9 passes. Matrix 14a encompasses a bed of **any ceramic**, **metal**, or **other heat-resistant media**, **including**: balls, preferably 3/4" diameter; saddles, preferably 0.5" to

1.5" nominal size; pall rings; **foam**, preferably having a void fraction of approximately 90% and about ten to thirty pores per inch; and honeycomb.

(12) Heater 28 may comprise an **electric arc ignitor**, a **catalytic section 31** (discussed herein below) or, preferably, **a resistive heating element** or **" glow plug"** that protrudes into matrix 14a. Alternatively, **heater 28 may be formed by an electrically conductive** portion 15, preferably a **metal foam**, within matrix 14, through which electricity may pass so as to enable portion 15 to function simultaneously as a resistance heating element and as a portion of the reaction matrix. The electrically conductive portion 15 may be formed in any shape that is conducive to proper heat transfer and electrical function, including for example, an annular loop, an inner core, a planar layer and the like.

(14) As used in this specification and in the appended claims, the terms "heating the matrix" and "heating at least a portion of the matrix" includes heating matrix 14a and directly heating process stream 9, which in turn heats matrix 14a. Moreover, **"heater 28"** as used in this specification, and the terms "heater" and "heating" as used in the appended claims, refer to any device or method of increasing temperature of the matrix, or increasing the temperature or **igniting process stream 9** or other streams, including but not limited to employing the **resistive heating element**, **glow plug,** electric arc ignitor, conductive portion 15, and catalytic portion 31 described in this application.

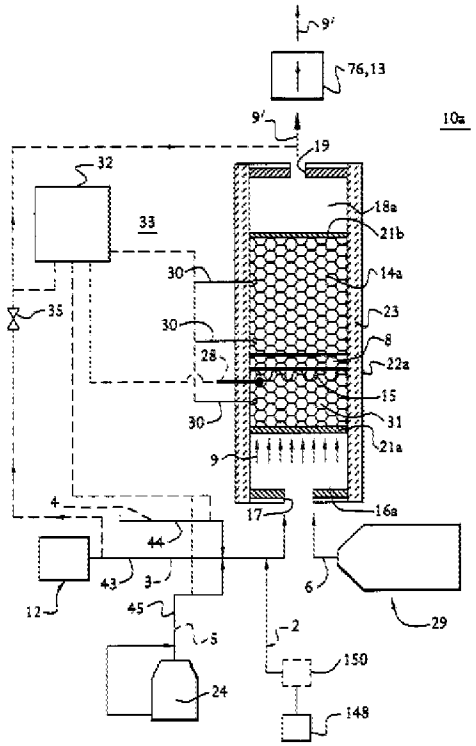
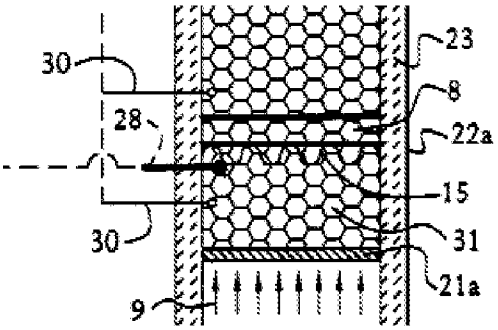
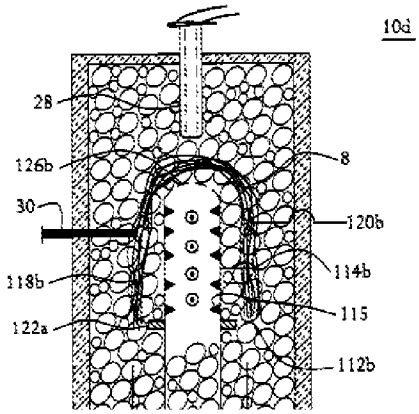


FIG. 1





US 6003305 (Martin et al) shows and discloses the invention substantially as set forth in the claims with possible exception to:

- an open pore ceramic foam having silicon carbide having a platinum catalyst.

US 6077620 (Pettit) teaches, form applicant's same catalytic reactor field of endeavor, that a reforming reaction is an endothermic reaction that requires external heat for the reaction to occur. The heat required to produce enough hydrogen varies with the demand put on the fuel cell system at any given point in time. Accordingly, the heating means for the reformer must be capable of operating over a wide range heat outputs. ***Heating the reformers with heat generated externally from either a flame combustor or a catalytic combustor is known***. **US 6077620 (Pettit)** discloses a ceramic foam material. A preferred mixing-media for bed 76 comprises **silicon carbide foam** having a porosity profile of about 25 pores per linear inch and a thickness of about one inch. Alternative mixing-media beds include refractory metal foams, ceramic pellets retained in a flow-through container, or a stack of fine (e.g., about 0.001 to about 0.010 openings per inch) metal or ceramic screens, wherein the openings of one screen are offset from the openings in adjacent screens to provide the desired tortuous path. The mixing-media bed 76 can also function as a flame suppressor to prevent any flame created at the light-off catalyst 74 from propagating back into the input end 64 of the combustor 56, and as a means to distribute the reaction mixture evenly across the leading face 72 of the catalyst bed 70. An **electric heating element 78** is provided upstream of the mixing media 76 and serves to vaporize liquid fuel entering the combustor 56, and to heat the gas entering the catalyst bed 70 during initial startup

of the combustor 56. The **heating element 78** may or may not be catalyzed, and is energized by electrical contacts 79 and 79' (FIG. 4) which are provided with electricity via electrical leads 104 and 104'.

US 6077620 (Pettit) discloses:

"(2) The present invention relates to **a fuel cell system having** a **combustor for heating a fuel reformer."**

"The **light-off foam 74** may comprise platinum on a **silicon carbide foam** substrate, and serves to light-off the reactants prior to their entering the catalyst bed 70, and also provides a tortuous path for mixing the reactants and promoting turbulent oxidation reactions."

"A **preferred mixing-media for bed 76** comprises **silicon carbide foam** having a porosity profile of about 25 pores per linear inch and a thickness of about one inch. Alternative mixing-media beds include **refractory metal foams**, **ceramic** pellets retained in a flow-through container, or a stack of fine (e.g., about 0.001 to about 0.010 openings per inch) metal or ceramic screens, wherein the openings of one screen are offset from the openings in adjacent screens to provide the desired tortuous path. The mixing-media bed 76 can also function as a flame suppressor to prevent any flame created at the light-off catalyst 74 from propagating back into the input end 64 of the combustor 56, and as a means to distribute the reaction mixture evenly across the leading face 72 of the catalyst bed 70."

"Preferred **mixing media** comprises **ceramic foams** having a porosity profile of about 25 pores per lineal inch to about 80 pores per lineal inch, but other materials and porosity profiles may be used. A preferred mixing-media for bed 76 comprises silicon carbide foam having a porosity profile of about 25 pores per linear inch and a thickness of about one inch. Alternative mixing-media beds include **refractory metal foams**, ceramic pellets retained in a flow-through container, or a stack of fine (e.g., about 0.001 to about 0.010 openings per inch) metal or ceramic screens, wherein the openings of one screen are offset from the openings in adjacent screens to provide the desired tortuous path. The mixing-media bed 76 can also function as a flame suppressor to prevent any flame created at the light-off catalyst 74 from propagating back into the input end 64 of the combustor 56, and as a means to distribute the reaction mixture evenly across the leading face 72 of the catalyst bed 70."

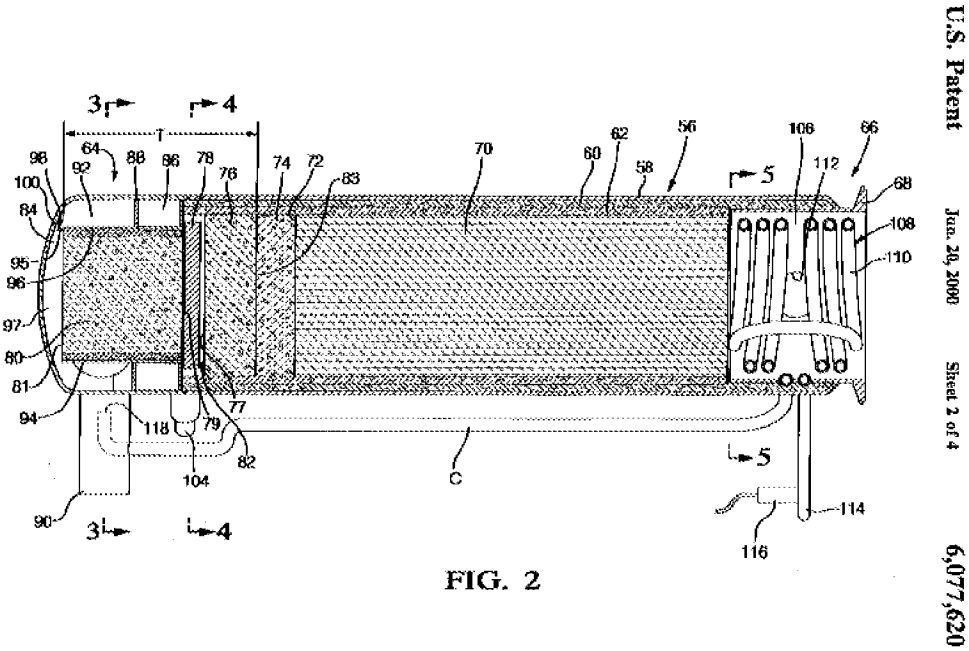


FIG. 2

US 20010028867 (Shimoda et al) teaches, form applicant's same catalytic reactor field of endeavor, forming "…heat-resistant porous bodies having communicating pores, a cell-sealed type ceramic honeycomb (400 cells/in.sup.2) of cordierite, and a ***ceramic foam of silicon carbide*** were prepared. Using these heat -resistant porous bodies, exhaust emission control devices were prepared by the same method as of Example 1, and evaluated. Table 5 shows the amounts of platinum supported on the heat -resistant porous bodies based on 100 parts by weight of the mixture of copper oxide and aluminum oxide, and the results of evaluation. The copper oxide used had a grain size of 1.1 .mu.m."

US 20010028867 (Shimoda et al) discloses:

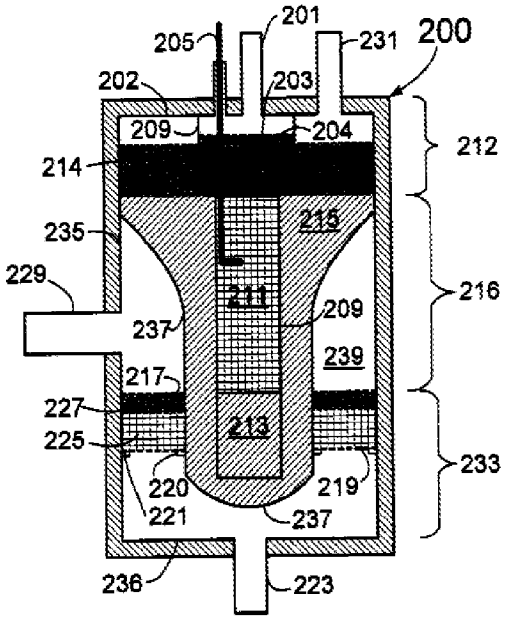
"[0017] The material for the heat-resistant porous body can be a metal such as Fe, Ni, Cr, Al, Mo, Ti, or a rare earth element, an alloy, or a **ceramic material** such as cordierite, mullite, zirconia, alumina or **silicon carbide**."

US 6190623 teaches from applicant's same porous combustor and heater field of endeavor, the use of a it is known to configured a porous combustion material (220, 225, 217, 227) to conduct heat via a wall (237) of the combustion chamber to the at least one of the

reforming process and the fuel cell process. And, wherein the fuel combusted in the porous member is anode waste gas from the fuel cell zone is essentially completely combusted.

US 6190623 shows:

Fig. 3



US 6190623 discloses:

(26) In the combined reaction zone apparatus 200, a first oxidation catalyst is disposed in the center core zone 211. A reforming catalyst is disposed in the lower core zone 213 and in the reforming zone 215. A second oxidation catalyst is disposed in the lower shell zone 233 between the top and bottom annular screens (217, 219). Optionally, a first layer of inerts is disposed above the first oxidation catalyst in the upper core zone 204. A second layer of inerts 214 is disposed in the upper shell zone 212 above the reforming zone 215. **A third layer of inerts 227** is disposed below the top annular screen 217 and **above the second oxidation catalyst 225.** The inert layers above the catalyst serve to support the catalysts during the assembly of the combined reaction zone apparatus 200 and to improve fluid distribution and **heat transfer within the combined reaction zone apparatus 200**. (Bolding and Highlighting added)

(27) The combined reaction zone apparatus 200 is shown which includes the functions of a partial oxidation zone 211, a reforming zone 215, a burner zone 239, a first internal heat transfer zone between the exhaust gases and the reforming zone and a second internal heat transfer zone between the partial oxidation zone 211 and the reforming zone 215. The partial oxidation zone 211 serves to provide heat to the reforming zone 215 and the

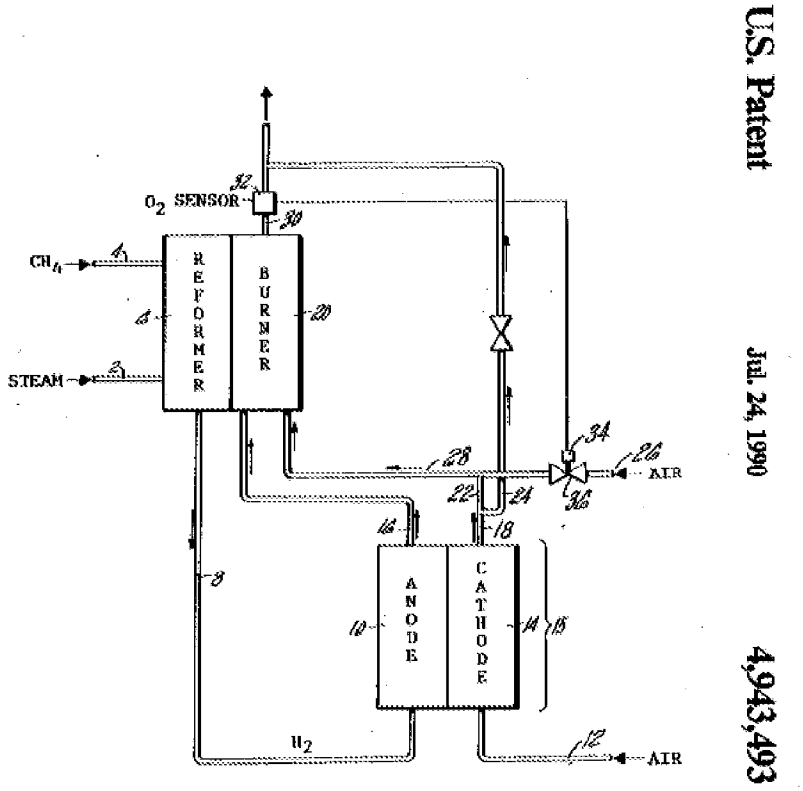
> heated reforming zone provides heat to ignite the burner zone 239. Thus, the apparatus includes two burner zones (211 and 239) wherein the first burner zone 211 provides heat to light the second burner zone 239 without the need for an igniter in the second burner zone. The first burner zone comprises the partial oxidation zone containing a first oxidation catalyst and the second burner zone comprises the burner zone. A second oxidation catalyst 225 is preferably disposed in the burner zone 239 to assist in the combustion of gases in the burner zone. **In the burner zone 239,** a fuel gas or a waste gas such **as anode waste gas from the fuel cell zone is essentially completely combusted**. (Bolding and Highlighting added)

In regard to **claims 11, 12, 14-18** and **20-24**, for the purpose of providing a suitable source of heat for a reformer, it would have been obvious to a person having ordinary skill in the art to modify, or use, the ceramic foam heat generator of **US 6003305 (Martin et al)** as a means for heating reformers with heat generated externally from either a flame combustor or a catalytic combustor, in view of the teaching of **US 6077620 (Pettit).** For the purpose of providing a suitable alternative high temperature heat and corrosion resistant porous ceramic foam material, it would have been obvious to a person having ordinary skill in the art to form the **US 6003305 (Martin et al)** porous member of a silicon carbide, in view of the teaching of **US 6077620 (Pettit)** or **US 20010028867 (Shimoda et al).** And, for the purpose of providing a more compact and alternative suitable means for heating heat source for the reformer, it would have been obvious to a person having ordinary skill in the art at the time of the invention to modify **US 6003305 (Martin et al)** such that the porous combustion material in contact with the wall conducts heat via the wall of the combustion chamber directly to the reforming process, in view of the teaching of **US 6190623**.Furthermore, in regard to **claims 11, 12, 14-18** and **20-24**, type of nozzle used to distribute fuel into the porous structure, the size, extent and shape of a flame would necessarily depend on numerous interrelated design parameters for any one given burner apparatus, such as the overall size and shape of the apparatus, the actual composition of fuel burned, desired operating temperatures, etc. to operate a foamed ceramic combustor of the type represented by **US 6003305 (Martin et al)** with either a swirl nozzle or multi-orifice nozzle and to size, extent and shape a flame in the manner set forth in the claims, can be viewed as nothing more than mere matters of choice in design absent e showing of any new or unexpected results

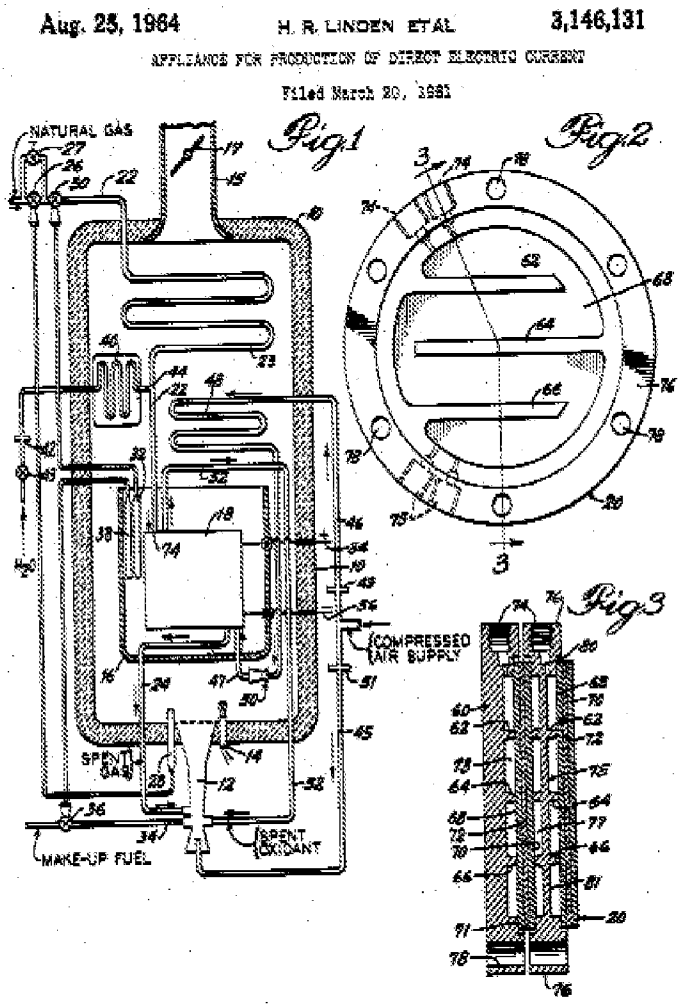
produced therefrom over the prior art of record. In regard to **claim 18** in particular, for the purpose of providing a suitable alternative high temperature heat and corrosion resistant porous ceramic foam material, it would have been obvious to a person having ordinary skill in the art to form the **US 6003305 (Martin et al)** porous member of a platinum coated ceramic foam having silicon carbide, in view of the teaching of **US 20010028867 (Shimoda et al).**

Conclusion

See any attached and previously presented USPTO forms 892 for prior art made of record and not relied upon which is considered pertinent to applicant's disclosure.



(7) In large scale fuel cell power plants, the hydrogen rich fuel gas is typically provided by steam reforming a hydrocarbon fuel to produce the hydrogen fuel. A reformer combustor provides heat to the reformer. Anode exhaust from the fuel cell is typically used as fuel in the reformer burner.



US 5829248 (Clifton):

(14) The preferred material for the **monolith thermal oxidizer-catalytic converter** stack is **reticulated** or **foam ceramic** with 10 pores per inch or more, but is not limited to this configuration or material, but can also be honeycomb or **cell structured with multiple small passageways** extending through the material, all passageways in parallel, with thin walls separating individual passageways. **Materials for the monolith stack are not limited to ceramics of various types, but can also be fabricated from other refractory materials, from metal, or metal composites, or metal alloys.**

(20) In a preferred embodiment for diesel powered mobile vehicles, a fuel supply system consisting of fuel pump or pumps, filters, valves, and injection nozzle or nozzles supplies diesel fuel to a combustion chamber where it is mixed with preheated exhaust gas from the pollution source. The **fuel source** is not limited to diesel fuel, but can include gasoline, various grades of fuel oil, propane, methane, natural gas or electricity. Appropriate fuel delivery means and control means appropriate to the particular fuel source deliver fuel to the combustion region. An ignition

system ignites the fuel-exhaust gas mixture. A **preferred embodiment for an ignition system** is an electrical spark ignition system consisting of one or more spark sources with spark electrodes located within the combustion region, but is **not limited to spark ignition** sources and can be **hot surface ignitors**, **hot wires**, **glow plugs,** flash lamp ignitor systems, laser ignitor systems, microwave ignitor systems, or pilot gas ignitor systems.

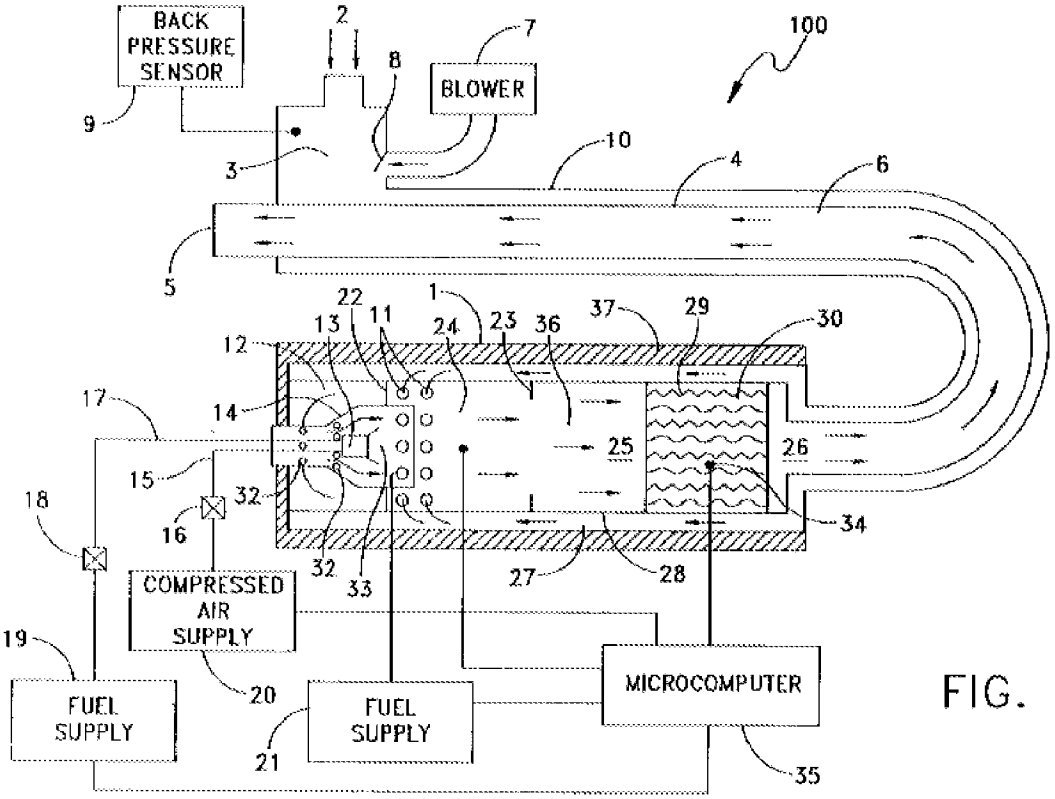


FIG. 1

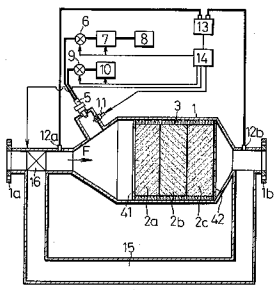
US 4450682 (Sato et al):

(21) The carbon particulates contained within the exhaust gas which is introduced within the casing 1 are caught by the filter member 2 and cleaned exhaust gas is discharged into the exhaust pipe E. As the volume of the carbon particulates caught by the filter member 2 is gradually increased, the differential pressure between the upper stream side of the filter member 2 and the downstream side thereof is increased. When the differential pressure reaches a predetermined value, the differential pressure detector 13 generates electrical signals to operate the control circuit 14. Then, electric current is supplied to the electromagnetic valve 16, **the glow plug 11**,

the **fuel pump 7**, the **air pump** 10, and the electromagnetic valves 6 and 9.

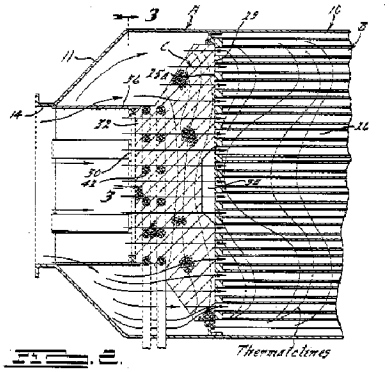
U.S. Patent May 29, 1984 Sheet 4 of 5 4,450,682

FIG.5



US 4744216 (Roe et al):

U.S. Patent May 17, 1988 Sheet 2 of 2 4,744,216



(14) Preferably the resistance heating means is energized to provide 800-1100 watts of heating, the resistance heating means being supplied with an electrical current of about 20 amps at a voltage of about 45. Advantageously the **ceramic foam body** contains a washcoat thereon comprising **a catalyst (palladium plus tungsten)** for reducing the ignition temperature of said siphon particulate collection to about 400.degree.-800.degree. F.

(13) The **ignition assembly D** ignites the siphoned collection of particulates in the open cell body by use of a much smaller energy supply. To this end, **electrical resistance wire**s 42 are **cast-in-place or embedded** within a radially centralized portion of the **open cell body** adjacent

to the entrance surface 30. The electrical resistance wires 42 when energized are effective to heat the body C during regeneration to a temperature to ignite the siphoned collection. The wires are here designed for a power supply of 20 amps and 45 volts from an alternator of the automobile, and deliver 800-1100 watts of heating. During energization of the electrical heating wires 42, the exhaust flow is bypassed around the filter trap B and **open cell body C** by operation of valve 20. A pump 43 is actuated to provide a flow of **oxygen carrying gas, such as air**, at a low flow rate of 1.5 to 10 cfm through the body C. This flow rate contrasts sharply with the normal flow rate of **exhaust gas** which fluxuates in the range of 100-1500 cfm.

US 4523935 (Takagi et al):

(36) When the ceramic structure is formed by porous ceramic composed of a ceramic skeleton having a three-dimensional network structure and having open type cells communicated with the outside and when said metallic body is an electric heater, there is provided a ceramic structure for purifying exhaust gas which can effectively remove fine carbon powder and the like from the exhaust gas derived from, for example, an internal combustion engine, such as a diesel engine, and which can be efficiently regenerated by burning out the fine carbon powder deposited in the ceramic structure at a low power consumption. The fine carbon powder deposited around the electric heater is locally and efficiently heated to an ignition temperature by the electric heater. Thereafter, the combustion is maintained by the heat of combustion of the carbon powder. Thus, the power consumption of the electric heater is minimized.

Fig. 3

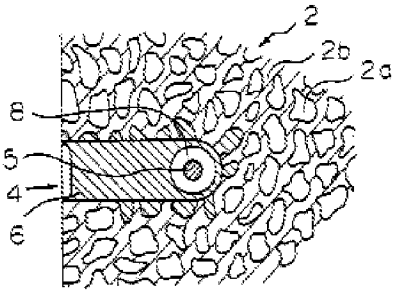
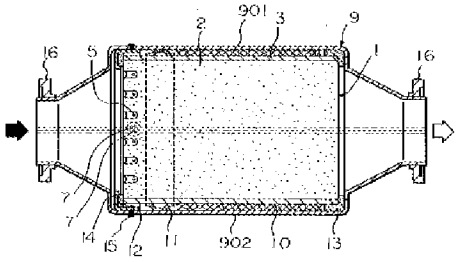
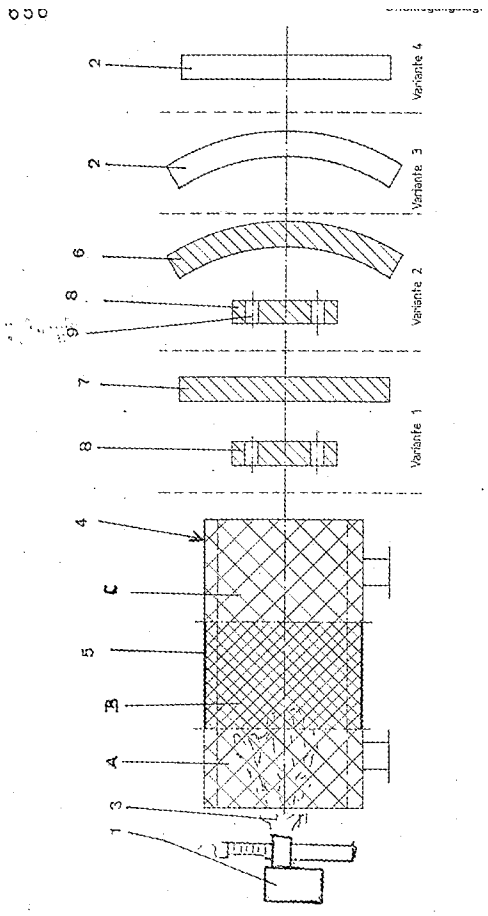


Fig. 4



DE003732656A1 shows and discloses a burner gaseous fossil fuels, with a baffle located ahead of the burner that causes vortices in the combustion gases, in which a flame guiding tube (4) surrounding the burner flame (3), and made of an at least **partially open pored foamed ceramic material,** is located between the burner (1) and the baffle (2). The flame guiding tube (4) has three zones (A, B, C) of differing porosity, with the two outer zones (A, C) having essentially the same porosity, and the central zone (B) have a lesser porosity and being provided

with a closed outer skin. A disc of open-pored foamed ceramic material may be provided in the passage of the **flame guiding tube (4).** Between the flame guiding tube (4) and the baffle (6, 7), another plate, of smaller extent than the baffle (6, 7), is located as a scattering plate (8); it may be provided with penetrations (9) for passage of the combustion gas, or be made of **foamed ceramic.** The parts may be made of a **catalytic material** (in the sense of effecting the conversion of noxious substances in the flue gas), or **coated with a material with such a catalytic effect.**

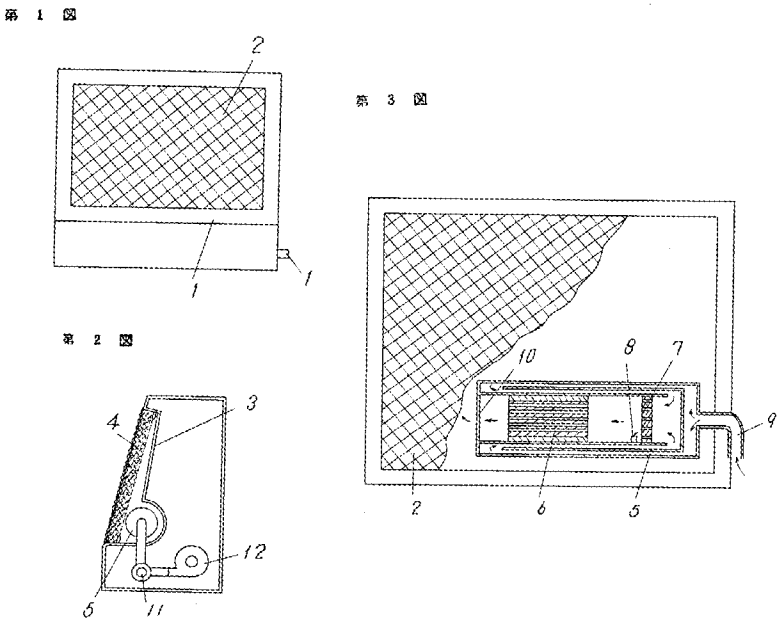


JP 59-131816 teaches, form applicant's same catalytic combustion field of endeavor field of endeavor, operating a foamed ceramic catalytic burner as an afterburner for consuming fuel produced in a **hydrocarbon gas reformer.**

JP 59-131816 discloses:

ABSTRACT:

CONSTITUTION: A **reforming unit 5** for **reforming hydrocarbon gas and** an **oxidation catalyst mat 4** for burning reformed gas are provided and the reforming unit 5 is held between the oxidation catalyst mat 4 and its rear surface panel 3. As reforming catalyst 6, **there is applied a catalyst** in which nickel, cobalt, iron, alkaline and alkaline earth, **platinum** etc. are held on an integrally formed body composed of grid-shaped or honeycomb-shaped multi-layered thin wall section made of non-organic heat resistant material such as alumina, silica and cordierite **and the like**. As the oxidation **catalyst mat 4**, there are provided a wool- shaped non-organic **heat resistant material such as** alumina, **silica** etc. or material having simple metal or composite metals of iron, chromium, cobalt, manganese, **platinum** etc. held in **foamed** metal, **foamed ceramic** etc.



US 5771683 A

TITLE: Active porous medium after treatment control system

The **foam member 30** may be made of any of a variety of known **conventional high temperature porous foams,** preferably of high temperature thermal shock and oxidation resistant metallic or ceramic composition. For example, the foam member 30 may be formed of zirconia, alumina, silicon nitride, silicon carbide or other similar materials. If the foam member 30 is formed of an **electrically conductive ceramic material**, **such as silicon carbide**, it can serve as one electrode of an ignition system for igniting the fuel-air mixture in the chamber 30, as described below in greater detail.

US 4777152 A

TITLE: **Porous silicon carbide sinter** and its production

Further, with respect to **porous sinters** having pores of a relatively larger sectional area, Japanese Patent Laid-Open No. 122016/1983, for example, discloses a process for producing an **electrically heat-generative silicon carbide** filter, comprising impregnating a polymer foam material with a **silicon carbide-based slurry**, eliminating said polymer foam material by heat treatment to **form** a **silicon carbide-based skeletal structure**, subjecting said structure to the primary baking in argon gas at a temperature of 1,900.degree. to 2,300.degree. C., subjecting it to the secondary baking in nitrogen gas at a pressure of 1 to 200 atm and a temperature of 1,600.degree. to 2,100.degree. C., and forming a heat -resistant electrode on each end of the structure to make it possible to pass an electric current therethrough, and Japanese Patent Laid-Open No. 81905/1973 discloses a process for producing a **porous ceramic material**, comprising impregnating an organic foam with a slurry containing a finely divided organic material, drying the foam thus impregnated, and baking the dried product, wherein the foam is impregnated with the slurry, after it is treated so that the particulate material in the slurry may adhere to the surface of the **foam structure**."

US 5117482:

TITLE: Porous ceramic body electrical resistance fluid heater

"A **highly desirable ceramic** for this invention is one which is electrically conductive with a positive temperature coefficient of resistivity, **high temperature resistant**, **chemically inert**, and has low density and **high thermal conductivity**. One example of such a desirable **porous ceramic material** for this invention is **silicon carbid**e, **SiC**, which is **intrinsically electrically conducting,** i.e. without reliance on added materials for electrical conductivity, and embodies the other noted attributes. **Silicon carbide** can be produced by fusing sand and coke at a temperature above about 4000.degree. F. to form large crystals of silicon carbide which are then crushed to provide smaller grains primarily for extensive use as an abrasive, in the range from 100-1000 mesh. However, silicon carbide finds other uses such as high temperature semiconductors and cathodes, and will withstand high temperatures to its decomposition temperature of about 4200.degree. F. Silicon carbide may be produced as self-bonded low density and **high density silicon carbide foams**. Low density **silicon carbide foam** has a density of about 17 lbs/ft..sup.3 with a **90% porosity**, and high density **silicon carbide foam** has a density of about 33 lbs./ft..sup.3 with **80% porosity**. Also, various additive metals in small particle form may be added to a mass of silicon carbide crystals to increase crystal to crystal bonding or modify the electrical characteristics of all or a part of the sintered body. A high desirable electrical P.T.C. porous silicon carbide body may be closely matched in electrical and physical characteristics not only to its function of being utilized as **an electrical heater** for a fluid passing therethough, but also matched to specific

> fluids. Silicon carbide has been found to be **desirably inert** to various **hot chemical process fluids** which are reactive to other porous body materials when rapidly heated to high temperatures while in contact with the porous body material. A preferred silicon carbide body of commensurate strength and electrical conductivity has a porosity in the range of from about 30% to about 50%.

THIS ACTION IS MADE FINAL.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

USPTO CUSTOMER CONTACT INFORMATION

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Carl D. Price whose telephone number is (571) 272-4880. The examiner can normally be reached on Monday through Friday between 9:00am-5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven B. McAllister can be reached on (571) 272-6785. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CARL D. PRICE/
Primary Examiner, Art Unit 3749